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DEVICE FOR DETERMINING AT LEAST ONE PARAMETER OF A MEDIUM FLOWING IN A LINE

Background Information

The present invention relates to a device for determining at least one parameter of a medium flowing in a line, having the features according to the definition of the species in the independent Claim 1.

A device is made known in DE 101 35 142 A1 for determining the mass of a medium flowing in a line, the device including a part capable of being introduced into the line in which a measuring channel with a measuring element is located. Devices of this nature are used, for example, as air-mass meters in the air-intake manifold of an internal combustion engine. Splash water, dust, and oil vapor can enter the air-intake manifold and be transported by the medium to the part of the device that is inserted in the line. To best prevent these contaminants from entering the measuring channel, the known device includes an inlet region that discharges into a separation zone, and a measuring channel that branches off from the inlet region, so that the media stream that entered the inlet region divides, and a partial stream reaches the inlet of the measuring channel. As a result, contaminants are best prevented from reaching the inlet of the measuring channel. The measuring channel includes a bent section downstream from its inlet, in which the partial stream of the medium that entered the measuring channel undergoes redirection. The disadvantage of this is that the stream may separate in the area of the bend and produce zones having a slower flow velocity, or even a backflow. Eddies and an

irregularly pulsating flow occur in the region when there is no contiguous flow. Since the bent section transitions into a further section equipped with the measuring element, the separation of the flow upstream from the sensor element has an unfavorable effect on the flow conditions at the sensor element, which can result in increased signal noise in the sensor signal. The resultant change in the sensor signal results in a disadvantageous deviation of the measured results from the values that are actually present.

Advantages of the Invention

In contrast, the device according to the present invention for determining at least one parameter of a medium flowing in a line having the characterizing features of Claim 1 has the advantage that a separation of the flow in the region of the bent section of the measuring channel is prevented. This is achieved via means that project into the measuring channel, which are located downstream from the inlet and upstream from the measuring element, as viewed in the measuring channel flow direction, the means directing the flow and counteracting a separation of the flow of the partial stream of medium from the channel walls of the measuring channel. The flow may be directed around the bend by the means with little or no separation, which improves the flow quality at the sensor element and reduces the signal noise.

Advantageous exemplary embodiments and further developments of the present invention are made possible by the features indicated in the dependent claims.

Advantageously, the means may include at least one single-component, continuous partition or an interrupted, double-component partition that is located in the measuring channel

transversely to the measuring channel flow direction. A plurality of partitions may also be situated behind each other or on top of each other in the measuring channel. The at least one partition is capable of being introduced into the measuring channel without a greater amount of manufacturing outlay. If a double-component partition is used, its two partial wall sections projecting toward each other from diametrically opposed interior wall sections of the measuring channel and being separated by a gap, then longitudinal eddies advantageously occur at the ends of the partial wall sections that face each other, the axis of this longitudinal eddy extending in the measuring channel flow direction and the flow being stabilized.

To prevent a film of water on the wall formed by water droplets that entered the measuring channel from detaching from the partition and resulting in water droplets coming in direct contact with the sensor element, it is particularly advantageous to position the back side – which faces away from the measuring channel flow – of the partition or the partial wall sections of the partition at an angle relative to the measuring channel flow direction that is less than ninety degrees and greater than zero degrees. The inclination of the back wall results in a cross-flow over the flow guide surfaces of the partition that extend parallel to the measuring channel flow, the cross-flow transporting water over the guide surfaces transversely to the measuring channel flow direction to the interior walls of the measuring channel, where the water is able to collect without reaching the sensor element.

Drawings

Exemplary embodiments of the present invention are presented in the drawings and are described in the subsequent description.

Figure 1 shows a cross section through a first exemplary embodiment of the part of the device, according to the invention, that is provided with the measuring channel, in a position in which it is inserted in the line.

Figure 2 shows an enlarged detailed view that shows a cross section perpendicular to the plane of the drawing in Figure 1 through the measuring channel in the area of the partition for a further exemplary embodiment of the invention.

Description of the Embodiments

Figure 1 shows a section of a line 3 through which a medium flows in a main flow direction 18. The line may be an intake manifold of an internal combustion engine, for example. The medium is the air that is flowing in the intake manifold toward the internal combustion engine, for example. A device 1 for determining a parameter of the medium flowing in line 3 is positioned in line 3 in such a manner that a part 6 of this device projects into line 3 and is exposed to the medium flowing there at a predetermined orientation. Device 1 for determining at least one parameter of the medium includes, in addition to part 6 introduced in the line, a carrier part (not shown) having an electrical connection, with evaluation electronics, for example, being housed in the carrier part. Device 1, with part 6, for example, may be inserted through an insertion opening 16 of a wall 15 of line 3, the wall 15 delineating a flow cross section of line 3. The evaluation electronics may be located within and/or outside of the flow cross section of line 3.

A measuring element 9 on a measuring element carrier 10 is used in device 1, for example, the measuring element being electrically connected to the evaluation electronics. Using measuring element 9, the volumetric flow rate or the mass flow rate of the flowing medium is determined as the parameter, for example. Further parameters that may be measured are, for example, pressure, temperature, concentration of a medium constituent, or flow velocity, which are capable of being determined using suitable sensor elements.

Device 1 has, e.g., a longitudinal axis 12 in the axial direction, which extends, e.g., in the direction of installation of device 1 in line 3, and which may also be the center axis, for example. The direction of the medium flowing in the longitudinal direction of line 3, referred to herein below as main flow direction 18, is labeled in Figure 1 with corresponding arrows 18, and extends there from right to left. When part 6 is installed in line 3, it is ensured that part 6 has a predetermined orientation relative to main flow direction 18 of the medium.

Part 6 has a housing having a, e.g., rectangular structure having a front wall 13 that, in the installed position, faces main flow direction 18 of the medium, a back wall 14 facing away therefrom, a first side wall and a second side wall and a third wall 19 that extends parallel to the main flow direction, for example. Part 6 further includes a channel structure located therein having an inlet region 27 and a measuring channel 40 that branches off from inlet region 27. The positioning of device 1 relative to line 3 ensures that the medium flowing in main flow direction 18 impacts part 6 in a predetermined direction, and a partial stream of the medium in this direction travels through an

opening 21 in front side 13 and reaches inlet region 27. Opening 21 may be oriented perpendicularly to main flow direction 18, for example, but another orientation of opening 21 relative to main flow direction 18 is also feasible. From inlet region 27 forward, a partial stream of the medium that entered the inlet region passes through an inlet 41 into measuring channel 40 that is equipped with measuring element 9 and that branches off from the inlet region. A portion of the medium in the inlet region continues to flow into a separation zone located downstream from the inlet of the measuring channel, this zone being connected to line 3 via at least one separation opening 33 located in the first side wall and/or the second side wall and/or wall 19.

Opening 21 in front side 13 of part 6 includes, in axial direction 12, a top edge 36 that is closest to measuring element 9 in axial direction 12. An upper, imagined plane 39 extends through top edge 36 and perpendicular to the plane of the drawing in Figure 1 and parallel to main flow direction 18. Separation opening 33 is located, in axial direction 12, below this upper plane 39. Inlet region 27 is provided, in the region of opening 21, with inclined or bent surfaces that are configured such that the medium flowing into the inlet region is directed away from upper plane 39. Liquid or solid-body particles that are contained in the partial stream of the medium that entered, and that are larger than and have a higher density than the gaseous flowing medium move in axial direction 12 away from upper plane 39. Since separation opening 33 is located below upper plane 39, the liquid and solid-body particles collect in separation zone 28 and are suctioned out into line 3 by the air that flows past separation opening 33.

Starting at inlet region 27, a partial stream of the medium passes through inlet 41 of measuring channel 40 and reaches a first, bent section 42 of the measuring channel. The partial stream of the medium that entered the measuring channel flows through the measuring channel in measuring channel flow direction a from inlet 41 to outlet 48 of the measuring channel. For clarification, it should be mentioned that, in the context of the present application, "measuring channel flow direction" is understood to be the direction of flow from the inlet to the outlet of the measuring channel, and not the velocity vectors of the individual flowing particles. The measuring channel flow direction therefore extends along the measuring channel and its bends to the outlet. The partial stream that traveled through inlet 41 into measuring channel 40 is redirected in first, bent section 42 and, at the end of section 42, reaches a further section 44, that extends nearly in a straight line and in which measuring element 9 is located. At the inner radius of bent section 42, the flow may separate from interior wall 43 of the measuring channel if countermeasures are not provided. In Figure 1, the separated flow is depicted by dashed line 60. Eddies and irregular pulsations develop in the separated flow, which have a disadvantageous effect on the flow in subsequent, further section 44 with measuring element 9.

To prevent the flow from separating in bent section 42, measuring channel 40 therefore includes means 50 projecting into the measuring channel, the means directing the flow and counteracting a separation of the flow from interior wall 43 of the measuring channel and, in the most favorable case, preventing it entirely. The partial stream of the medium then flows, without separating, into further section 44 of the measuring channel. In an advantageous exemplary embodiment, the means include at least one single-component,

continuous partition 50, which is located transverse to measuring channel flow direction a in the transitional region from bent section 42 to further section 44. Partition 50 is attached with two end sections facing away from each other and that are not shown in Figure 1 to diametrically opposed wall sections of the interior wall of the measuring channel in such a manner that a line that connects the two end sections of the partition extend nearly perpendicular to measuring channel flow direction a and, therefore, in Figure 1, also perpendicular to the plane of the drawing. The partition includes a narrow front side 53 that faces measuring channel flow direction a, a back side 54 facing away therefrom, and two flow guide surfaces 51 and 52 extending essentially parallel to the measuring channel flow direction. The partition may be rounded off at front side 53 and have a guide vane geometry or guide blade geometry.

As shown in Figure 2, in another exemplary embodiment, partition 50 may also be configured as two components and include two partial wall sections 50a and 50b that are attached with end sections 55a and 55b to diametrically opposed internal wall sections 45a, 45b of measuring channel 40 and project toward each other and are preferably separated by a gap 59. Front sides 53a and 53b of the partial wall sections are oriented preferably perpendicular to measuring channel flow direction a. It is particularly preferable when back sides 54a and 54b of partial wall sections 50a, 50b are preferably flat and, as viewed in the cross section of Figure 2, form an angle α with measuring channel flow direction a that is less than ninety degrees and greater than zero degrees, and is preferably less than 70 degrees and greater than thirty degrees. If partition 50 has a single-component configuration as depicted in the exemplary embodiment in Figure 1, the single back wall may be oriented relative to the measuring channel flow direction

at an angle that is less than ninety degrees and greater than zero degrees. The transverse position of back sides 54a, 54b in Figure 2 results in a transverse flow in the direction of arrow b over flow guide surfaces 51 and 52 extending parallel to measuring channel flow direction a, the transverse flow transporting water contained in the flow over the flow guide surfaces transverse to measuring channel flow direction a to interior walls 45a and 45b of the measuring channel, where water 61 is able to collect without reaching sensor element 9.

Downstream from partition 50 in Figure 1 or partial wall sections 50a and 50b in Figure 2, the medium flows into further section 44 toward measuring element 9. The cross section of further section 44 tapers in measuring channel flow direction a, which is achieved via two acceleration ramps that face each other, whereby, in the depiction in Figure 1, the observer is looking at a first ramp from a perpendicular perspective. As a result of the tapering of the cross section and/or the acceleration ramps in the form of a narrowing of the lateral surfaces of measuring channel 40 on all sides or partially, the medium is transported rapidly through the measuring channel in measuring channel flow direction a and, as a result, suctions air coming after it out of inlet region 27. From further section 44 forward, the medium is redirected downstream from measuring element 9 into a channel section 47 that extends away from insertion opening 16 approximately in axial direction 12. From this channel section forward, it is redirected into a final channel section 48 that extends, e.g., against main flow direction 18, and passes through outlet 49 of measuring channel 40, which is located, e.g., perpendicular to main flow direction 18 or at an angle to main flow direction 18, that is different from zero degrees, back into line 3.